PATENT ABSTRACTS OF JAPAN

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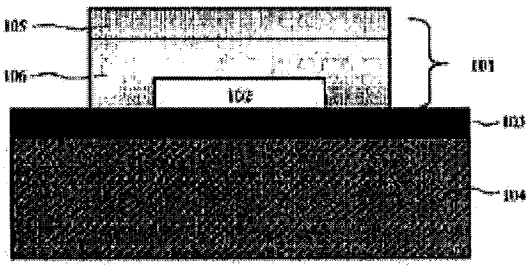
(54) SOLAR CELL MODULE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a solar cell module which is capable of preventing a photovoltaic device from deteriorating in conversion efficiency due to temperature rise in it, and especially a high-condensed solar cell module which is capable of preventing a photovoltaic device from deteriorating in conversion efficiency due to the temperature rise in it.

SOLUTION: The photovoltaic device 102 of a light condensing solar cell module is sealed with a thermally conductive sealer 101, and heat released from the photovoltaic device 102 is discharged to other members or the air.



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CLAIMS

[Claim(s)]
[Claim 1]In a solar cell module which has a condensing means which condenses sunrays, and a tailing means to follow the sun, receives sunrays which condensed by a photovoltaic cell, and obtains an output, A solar cell module closing said photovoltaic cell with a thermally conductive sealing agent, and emitting heat of said photovoltaic cell to other members or atmospheres via this sealing agent.
[Claim 2]The solar cell module according to claim 1, wherein the surface of said sealing agent has unevenness.
[Claim 3]The solar cell module according to claim 1 or 2, wherein said sealing agent consists of a sealing agent outer layer and a sealing agent inner layer.
[Claim 4]The solar cell module according to claim 3, wherein said sealing agent outer layer has moisture vapor transmission lower than said sealing agent inner layer.
[Claim 5]The solar cell module according to claim 3 or 4, wherein an antireflection film is provided in said sealing agent outer layer.
[Claim 6]The solar cell module according to any one of claims 1 to 5, wherein said sealing agent contains a filler.
[Claim 7]The solar cell module according to claim 6 in which thermal conductivity of said filler is characterized by being higher than thermal conductivity of a photovoltaic cell.
[Claim 8]The solar cell module according to claim 6 or 7, wherein thermal conductivity of said filler is more than 150W/m and K.
[Claim 9]The solar cell module according to any one of claims 6 to 8 characterized by coming to choose said filler from alumimium nitride, magnesium oxide, or beryllium oxide at least.
[Claim 10]The solar cell module according to any one of claims 1 to 9, wherein said photovoltaic cell has an output extraction electrode in the non-acceptance surface side.
[Claim 11]The solar cell module according to any one of claims 1 to 10, wherein a Fresnel lens

is used for said condensing means.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the condensed type solar cell module which follows the sun, irradiates a photovoltaic cell with the sunlight which condensed, and obtains electric power, and relates to the solar cell module which suppressed the rise in heat of the photovoltaic cell by receiving the light which condensed in detail.
[0002]
[Description of the Prior Art]A solar cell module can be classified into two kinds according to the method of receiving sunrays in a photovoltaic cell. That is, there are a solar cell module which receives sunrays by a photovoltaic cell as it is, and a condensed type solar cell module which condenses sunrays and receives light by a photovoltaic cell. A solar cell module may make the sun follow a solar cell module, in order to receive sunrays more efficiently, when a stand is fixed.
[0003]Conversion efficiency increases by condensing and a condensed type solar cell module has the merit that area of a photovoltaic cell can be made small. The output current of a photovoltaic cell increases in proportion to condensing magnification. in addition -- following output voltage on the increase in the output current by condensing theoretically -- logarithm -- it increases-like. Therefore, only the increment of light conversion efficiency of output voltage improves by making condensing magnification increase. Since the size of a photovoltaic cell becomes small in inverse proportion to condensing magnification in order to obtain the same output, the cost which a photovoltaic cell occupies in a module is reducible. Then, sunrays are condensed and the solar cell module of the type which follows the sun attracts attention these days.
[0004]**** [a rise of temperature / produce / on the other hand, / a photovoltaic cell / decline in conversion efficiency] Since the sunrays which condensed to the photovoltaic cell are

irradiated with a condensed type solar cell module, compared with the usual solar cell module, its rise of the temperature of a photovoltaic cell is remarkable. When it is considered especially as 200 or more-time condensing magnification, a photovoltaic cell becomes an elevated temperature dramatically.

[0005]

[Problem(s) to be Solved by the Invention]In order to prevent decline in the conversion efficiency by the rise in heat of such a photovoltaic cell, improving the heat dissipation nature of a photovoltaic cell was proposed variously, but SUBJECT which is mentioned later, respectively occurred.

[0006]For example, providing the electrode which is from the good thermal conductivity metallic material which has rugged structure on a light incidence face side in JP,H6-45623,A, and also providing unevenness on the surface of a photovoltaic cell is proposed. Surface area is increased by giving rugged structure, a touch area with the atmosphere etc. is extended, and heat is effectively emitted to the exterior.

[0007]However, a photovoltaic cell is usually used, closing it with a sealing agent, in order to protect this element from moisture or external power. Therefore, although the surface of a photovoltaic cell will contact a sealing agent and heat will move to a sealing agent, the usual sealing agent has low thermal conductivity, and there are few radiation effects.

[0008]The electrode formed in the acceptance surface of a photovoltaic cell is extended to the acceptance surface exterior, and the solar cell module which has a means to cool to the extension is proposed by JP,H11-8401,A. This prevents the thickness of a solar cell module becoming thick by providing a cooling method in the rear-face side of a photovoltaic cell.

[0009]However, since the electrode is provided in the acceptance surface side like the above-mentioned example of precedence, the portion to which light does not strike upon a photovoltaic cell by this electrode will arise. A temperature gradient may produce it on a photovoltaic cell this not only cannot use sunrays effectively, but, and a photovoltaic cell may break. In the case of a condensed type solar cell module, the possibility is especially high.

[0010]Furthermore, a heat sink is pasted together to the rear face of a photovoltaic cell, and the solar cell module which cools a photovoltaic cell is proposed by JP,2000-68539,A. This cools a photovoltaic cell from the rear-face side.

[0011]However, when closing to a photovoltaic cell in the case of such cooling structure, a temperature gradient will arise in the surface [of a photovoltaic cell], and rear-face side. Such a temperature gradient may produce distortion in a photovoltaic cell, and a photovoltaic cell may break.

[0012]And the optoelectric transducer which provides the film of infrared reflexibility and/or infrared absorption nature in the optical input side of an optoelectric transducer is proposed by JP,H10-190017,A. This intercepts the light of the portion used as heat, and prevents the rise in

heat of an optoelectric transducer.

[0013]However, although it is possible to prevent the rise in heat of an optoelectric transducer in this case, a photovoltaic cell has sensitivity in the light of an infrared portion in many cases, and has a possibility of causing decline in conversion efficiency.

[0014]Then, an object of this invention is to provide the solar cell module which can prevent conversion efficiency from being able to prevent decline in the conversion efficiency by the rise in heat of a photovoltaic cell, and the photovoltaic cell of a high condensing type solar cell module carrying out a rise in heat especially in light of the above-mentioned problems, and falling.

[0015]

[Means for Solving the Problem]That the above-mentioned purpose should be attained a solar cell module of this invention, In a solar cell module which has a condensing means which condenses sunrays, and a tailing means to follow the sun, receives sunrays which condensed by a photovoltaic cell, and obtains an output, A photovoltaic cell is closed with a thermally conductive sealing agent, and heat of a photovoltaic cell is emitted to other members or atmospheres via this sealing agent.

[0016]According to the solar cell module of this invention, it becomes possible to prevent a rise in heat of a photovoltaic cell and to prevent decline in conversion efficiency.In a solar cell module of this invention, it is preferred that the surface of the above-mentioned sealing agent has unevenness. Thereby, especially heat dissipation nature to the atmosphere can be made to improve.

[0017]It is preferred that the above-mentioned sealing agent consists of a sealing agent outer layer and a sealing agent inner layer. Thereby, a function, for example, weatherability, and moisture vapor transmission of a sealing agent can be made to improve.

[0018]As for the above-mentioned sealing agent outer layer, it is preferred that moisture vapor transmission is lower than the above-mentioned sealing agent inner layer. The above-mentioned moisture vapor transmission can be made to improve thereby especially.

[0019]And it is preferred that an antireflection film is provided in the above-mentioned sealing agent outer layer. Thereby, an output can be made to improve.

[0020]As for the above-mentioned sealing agent, it is preferred to contain a filler. Heat conduction through a sealing agent can be performed more promptly by this, and a coefficient of linear expansion of sealing resin can be brought close to a coefficient of linear expansion of a photovoltaic cell, and the possibility of exfoliation by a temperature change etc. can be reduced, and a mechanical strength of sealing resin can be made to improve.

[0021]It is preferred that thermal conductivity of the above-mentioned filler is higher than thermal conductivity of a photovoltaic cell, and it is preferred that it is especially more than 150W/m and K. Thereby, thermal conductivity from a photovoltaic cell to a sealing agent

becomes good. [0022]In addition, it is preferred to come to choose the above-mentioned filler from alumimium nitride, magnesium oxide, or beryllium oxide at least. Thereby, the degree of mixture of light can be made to rise. [0023]As for the above-mentioned photovoltaic cell, it is preferred to have an output extraction electrode in the non-acceptance surface side. This becomes possible to prevent a loss of an output by a shadow of an electrode. [0024]As for the above-mentioned condensing means, it is preferred to use a Fresnel lens. Thereby, a condensing means can be miniaturized. [0025]

[Embodiment of the Invention]Although the suitable embodiment of this invention is described hereafter, this invention is not limited to this embodiment.

[0026]The solar cell module of this invention serves as a condensing member which condenses sunrays from the receiver which changes the condensed light into electric power. In them, it has a means to follow the sun.

[0027]Drawing 1 is a schematic diagram showing a receiver's composition in the solar cell module of this invention. As for a sealing agent and 102, in drawing 1, a substrate and 104 are cooling members a photovoltaic cell and 103 101. The sealing agent 101 may be divided into the outer layer 105 of a sealing agent, and the inner layer 106 of the sealing agent.

[0028]The sealing agent 101 is extended outside the circumference of the photovoltaic cell 102, and is contacted in substrate 103 grade. Thereby, the heat transfer not only to the heat dissipation to the atmosphere but other members can be used now.

[0029](Sealing agent) The sealing agent 101 protects the photovoltaic cell 102 from light, moisture, external force, etc. The electrical link portion of the photovoltaic cell 102 and the substrate 103 is also protected from moisture etc. As the characteristic for which the sealing agent 101 is asked, it excels in thermal conductivity, lightfastness, heat resistance, and moisture resistance, and the transmissivity of light is high, and it is excelling in adhesion with a photovoltaic cell etc. When the characteristic independently mentioned above cannot be filled, it is also possible to use two or more layers of the sealing agent outer layer 105 and sealing agent inner layer 106 grade.

[0030]<Thermal conductivity> The thermal conductivity for which the sealing agent 101 in this invention is asked is carrying out heat transfer of the heat of the photovoltaic cell 102 to the atmosphere or other members promptly. Therefore, as for the sealing agent 101, it is preferred that thermal conductivity is high. When silicone resin is used for the sealing agent 101, thermal conductivity is 0.1 - 0.3 W/m-K, but it is possible by mixing a filler to raise even for example, 1.7W/m and K.

[0031]<Lightfastness> The lightfastness for which the sealing agent 101 is asked is hard to deteriorate by the sunrays which condensed. Degradation as used in the field of this invention means the fall of transparency, the fall of adhesion, the fall of a mechanical strength, etc. The tolerance over the ultraviolet rays which increased intensity especially by condensing is

needed. When the lightfastness of sealing resin itself is insufficient, an ultraviolet ray absorbent etc. are added or an ultraviolet absorption film is provided.
[0032]On the other hand, since it protects these members itself from ultraviolet rays when a condensing member is a Fresnel lens which consists of an acrylic resin, polycarbonate resin, etc., and in being the reflector which gave vacuum evaporation of aluminum or silver to the same resin, it may have a function which absorbs ultraviolet rays. In such a case, there is no necessity of providing addition of an ultraviolet ray absorbent and an ultraviolet absorption film.

[0033]<Heat resistance> Are the heat by receiving the light which condensed and the heat resistance for which the sealing agent 101 is asked is hard to deteriorate. Degradation as used in the field of this invention like lightfastness says the fall of transparency, the fall of adhesion, the fall of a mechanical strength, etc. To especially heat, creep resistance is needed. Usually, although the receiver of a condensed type solar cell module cools with the surface and the rear face, temperature will be 50 thru/or about 100 **. A receiver becomes various angles when a solar cell module follows the sun. Therefore, it is not necessary to carry out creep of the sealing agent at the above-mentioned temperature.
[0034]In order to improve creep resistance, it is possible to stop mobility according to bridge construction, when the melting point is low, and to improve opposite creeping property using material with the high melting point. Although it is usable in a method publicly known as the method of bridge construction of a sealing agent, bridge construction of the process which gas does not generate is more preferred. For example, in bridge construction of silicone rubber, what is depended on the addition reaction using the catalyst of a platinum compound etc. which uses a peroxide, the thing to depend on the condensation reaction by heating, the thing to depend on the condensation reaction which uses a catalyst and moisture, the thing to depend on UV irradiation, etc. are mentioned, but. There is no by-product according [what is depended on the addition reaction using the catalyst of a platinum compound etc.] to a reaction, and it is desirable. When making especially silicone resin into a sealing agent inner layer and using the low thing of permeability, such as glass, for a sealing agent outer layer, by producing a by-product, in a sealing agent, the cellular remainder etc. may occur and a receiver's reliability may be spoiled.
[0035]In order to prevent oxidation by heat, an antioxidant may be added to the sealing agent 101.
[0036]<Moisture resistance> The moisture resistance for which the sealing agent 101 is asked is hard to deteriorate with moisture etc. In order to protect the photovoltaic cell 102 from moisture, it is preferred that moisture vapor transmission is low. When independent moisture vapor transmission is insufficient, it is also possible to adopt composition of two or more layers, such as a sealing agent outer layer and a sealing agent inner layer, and to use for a sealing

agent outer layer what has the low moisture vapor transmission of glass etc.
[0037]<Translucency> Although the translucency for which the sealing agent 101 is asked changes with photovoltaic cells 102 to be used, it is preferred to have the transmissivity of not less than 90% in the wavelength of 300 nm - 1000 nm. However, in order to raise the lightfastness of the sealing agent 101, it is unavoidable to make light of 400 nm or less hard to penetrate. An antireflection film may be provided in order to raise transmissivity.
[0038]<Adhesion> The adhesion for which the sealing agent 101 is asked needs for adhesion with the photovoltaic cell 102 and the substrate 103 to be good. When a sealing agent is constituted by the sealing agent inner layer 106 and the sealing agent outer layer 105, it is required for adhesion mutual [these] to be also good. In order to improve adhesion, the bonding assistant which improves adhesion, such as a silane coupling agent, to the sealing agent 101 may be mixed. Processing which raises adhesive strength to the photovoltaic cell 102, the substrate 103, and the adhesion side of the outer layer 105 may be performed.
[0039]The sealing agent 101 which fills the above characteristics is the two-layer composition of the sealing agent outer layer 105 and the sealing agent inner layer 106, for example, and what contains a filler in the sealing agent inner layer 106 is mentioned. A concrete material in such composition is shown below.
[0040](Sealing agent outer layer) Glass, a resin film, etc. are mentioned as the sealing agent outer layer 105 which fills the above-mentioned characteristic. Glass is effective in order to stop moisture vapor transmission low especially. On the other hand, although an acrylic, polyester, a fluoro-resin, etc. are mentioned as a resin film, a fluoro-resin is suitably used lightfastness and in respect of heat resistance. The refractive index of a fluoro-resin is low and it is effective also from a viewpoint of suppressing reflection. As such a fluoro-resin, a tetrafluoroethylene hexafluoropropylene copolymer, A tetrafluoroethylene perfluoroalkyl vinyl ether copolymer, polychlorotrifluoroethylene resin, polyvinylidene fluoride, polyvinyl fluoride, an ethylene-tetrafluoroethylene copolymer, and an ethylene-chlorotrifluoroethylene copolymer are mentioned. Especially polychlorotrifluoroethylene resin has low moisture vapor transmission, and is used suitably. As for these, it is preferred to process to the field which touches a sealing agent inner layer in order to raise adhesion with the sealing agent inner layer 106. For example, it is preferred to perform corona discharge treatment, plasma discharge processing, ozonization, or coating of a primer.
[0041]In these sealing agent outer layer 105, it is preferred that it is uneven. It is possible to use the method of it being uneven beforehand and also transferring unevenness in a sealing process.
[0042]When the refractive index is high, it is also possible to provide an antireflection film. For example, vapor-depositing MgF etc. or applying the paint of a fluoro-resin system etc. is mentioned.

[0043](Sealing agent inner layer) Silicone resin, a fluoro-resin, etc. are mentioned as the sealing agent inner layer 106 which fills the above-mentioned characteristic. Especially in the method of hardening liquefied silicone resin and using, a process is easy and mixing of a filler, etc. can be performed easily.

[0044](Filler) As stated previously, when the sealing agent 101 generally consists of resin, in the case of silicone resin, the thermal conductivity of the resin is about 0.1-0.3 W/m-K. It is possible by mixing a filler to make it improve to for example, 1.7 W/m-K. In this invention, fillers are the particles of the inorganic compound of a grain, fibrous, tabular, or amorphous state.

[0045]As a filler used suitably for this invention, An aluminum oxide (thermal conductivity 17 W/m-K), silicon carbide (thermal conductivity 42 W/m-K), Silicon nitride (thermal conductivity 21 W/m-K), magnesium oxide (thermal conductivity 419 W/m-K), Although inorganic compounds, such as boron nitride (the thermal conductivity 1300 - 30 W/m-K), alumimium nitride (thermal conductivity/mof 170W andK), beryllium oxide (thermal conductivity 230 W/m-K), glass (thermal conductivity 1.2 W/m-K), and silica (thermal conductivity 0.5 W/m-K), are mentioned, Of course, it is not necessarily limited to these.

[0046]In a condensed type solar cell module, what can make the degree of mixture high is preferred, and an aluminum oxide, silicon carbide, silicon nitride, magnesium oxide, boron nitride, and alumimium nitride are more preferred.

[0047]When thermal conductivity is 150 or more W/m-K, the radiation effect of sealing resin increases greatly and inorganic compounds, such as thermally conductive, comparatively big alumimium nitride, magnesium oxide, and beryllium oxide, are chosen preferably especially. As for the particle diameter, it is preferred that they are 0.1 micrometer thru/or 100 micrometers as concrete particle diameter.

[0048]In the case of a condensed type solar cell module, the high degree of mixture of the condensed light is required. Because, when the degree of mixture is low, a portion with it and a small portion will exist in the surface of the photovoltaic cell 102, the temperature of the photovoltaic cell 102 goes up rapidly in a big portion with extraordinary light intensity, and the photovoltaic cell 102 may be destroyed. [remarkable light intensity and] [big] In this invention, the thermal conductivity of beryllium oxide, alumimium nitride, magnesium oxide, etc. is very high, and it is effective in raising the degree of mixture of light by using what has light reflex nature.

[0049]As for points, such as a mechanical strength of sealing resin, to the mixed amount, it is preferred that it is 10 thru/or 50 volume %. In the case of silicone resin, the tensile strength of silicone resin becomes with the maximum within the limits of this. On the other hand, from a thermally conductive point, it is preferred that it is 30 thru/or 80 volume %. As for the mixed amount of the above thing to a filler, it is preferred that it is 30 thru/or 50 volume %.

[0050]In order to heighten adhesive strength with sealing resin, a surface treatment may be

performed to a filler. For example, it processes by finishing agents, such as the Silang system, a titanate system, and an aluminate system. As the method of processing, the method of processing a filler beforehand, the method of mixing the processing agent to sealing resin, etc. are mentioned.

[0051]These fillers may mix what may use it, mixing two or more kinds, and has two or more kinds of particle diameter.

[0052](Photovoltaic cell) As the photovoltaic cell 102 used suitably for this invention, compound semiconductor systems, such as a crystalline silicon system (thermal conductivity 140 W/m-K), GaAs (thermal conductivity 54 W/m-K), CdTe, CdS, and CIS (CuInSe), etc. are mentioned. As for the electrode which takes out the output of the photovoltaic cell 102, in order to lose the loss of the incident light by the shadow of an electrode, it is preferred to be formed in the rear face of the photovoltaic cell 102. In order to use incident light effectively, it is preferred to form texture structure in the surface of the photovoltaic cell 102.

[0053](Substrate) What consists of a conductive member electrically connected with the photovoltaic cell 102 as the substrate 103 used for this invention and an insulating member which insulates the photovoltaic cell 102 and the cooling member 104 is mentioned. It electrically connects with the electrode of + and - which are output extraction of the photovoltaic cell 102, respectively, and a conductive member is outputted to the exterior.

[0054]The above-mentioned conductive member and the connection of an electrode can use solder, conductive adhesives, etc. The adhesion of an above-mentioned conductive member and insulation member can be [using what pasted the conductive member together to the insulation member beforehand] possible, and can also paste an insulating member together with adhesives etc. after adhesion of the photovoltaic cell 102 and a conductive member. Adhesion of the substrate 103 and the cooling member 104 is also the same.

[0055]As the above-mentioned conductive member, resistance is low, thermal conductivity is high, and it is preferred that it is stable to moisture etc. Copper etc. are mentioned as a concrete material.

[0056]It is called for that insulation is high and thermal conductivity is high as the above-mentioned insulation member. Alumimium nitride, an aluminum oxide, etc. are mentioned as a concrete material.

[0057]As the substrate 103 suitably used in this invention, the laminated circuit board of copper / alumimium nitride / copper, and copper / aluminum oxide / copper, etc. are mentioned.

[0058](Cooling member) The cooling member 104 used for this invention is for preventing the rise in heat of the photovoltaic cell 102. As a cooling method, although water cooling, air cooling, etc. are mentioned, it is also possible to use thermoelements, such as a Peltier device.

[0059](Condensing member) In this invention, it is [means / to condense] usable in a publicly known method. For example, the method of using a Fresnel lens, the method of using a light reflector, etc. are mentioned.
[0060](Tracking apparatus) In this invention, it is [means / to follow the sun] usable in a publicly known method.
[0061]
[Example]Hereafter, although this invention is explained in detail based on working example, this invention is not limited to these working example.
[0062][Working example 1] In this example, in order to assemble an evaluation module, the receiver of composition of being shown in drawing 2 was created.
[0063]First, as a receiver's members forming, as shown in drawing 2, the sealing agent outer layer 201, the sealing agent inner layer 202, the photovoltaic cell 203, the substrate 204, and the cooling member 205 were prepared.
[0064](Sealing agent outer layer) As the sealing agent outer layer 201, white sheet glass (1-mm thickness) was prepared.
[0065](Creation of a sealing agent inner layer) Aluminum oxide (mean particle diameter of 1 micrometer) 240 weight section was prepared as a filler with 2 liquid addition type liquid silicone 100 weight section as the sealing agent inner layer 202. The above was mixed and deaerated.
[0066](Photovoltaic cell) The photovoltaic cell of single crystal silicon was prepared as the photovoltaic cell 203.
[0067](Substrate) As the substrate 204, the substrate of the three-layer laminated structure of copper / alumimium nitride / copper was prepared.
[0068](Cooling member) The heat sink was prepared as the cooling member 205.
[0069]The above member was assembled by the following methods.
[0070]Soldering paste was printed to the position on the substrate 204, and the photovoltaic cell 203 was laid in the position. The reflow furnace was used, this was heated and cooled and the substrate 204 and the photovoltaic cell 203 were unified.
[0071]Next, the adhesives of heat-conducting characteristic were applied to the cooling member 205, it pasted together to what unified the substrate 204 and the photovoltaic cell 203, and heat cure was carried out with the hot air drying furnace.
[0072]Finally, the sealing agent inner layer 202 was dropped on the photovoltaic cell 203, the sealing agent outer layer 201 was carried on it, and it put into the vacuum chamber, and deaerated again. Then, heat cure was carried out with the hot air drying furnace.
[0073]Next, the receiver's electrical property at 25 ** was measured using the simulator.
[0074]The obtained receiver was set to the condensing system using the Fresnel lens shown in drawing 3, and the solar cell module was assembled. Condensing magnification was made

into 250 times. As for 301, in drawing 3, a case and 303 are receivers a Fresnel lens and 302.
[0075]And the following techniques estimated the obtained solar cell module.
[0076](Outdoor exposure test) It installed in the solar tracking apparatus which does not illustrate the obtained solar cell module, the outdoor exposure was performed, and the temperature of a photovoltaic cell and the conversion efficiency of the solar cell module were measured there. It is shown in Table 1 as a relative value over the value which measured the measurement result of this conversion efficiency using the simulator beforehand.
[0077](High-humidity/temperature examination) After doing the high-humidity/temperature examination of 85 **, 85%, and 5000 hours for the obtained receiver, conversion efficiency was measured like the above-mentioned outdoor exposure test. Viewing estimated appearance. The following valuation bases estimate and the result is shown in Table 1.
O : -- what produced the thing x:exfoliation etc. which did not produce change in appearance, and did not produce change in the thing **:appearance which does not produce not less than 3% of fall in conversion efficiency, but produced 5% or less of fall not less than 3% in conversion efficiency [0078][Working example 2] The receiver was created like working example 1. The obtained receiver was set to the solar cell module using the reflector shown in drawing 4. Condensing magnification was made into 250 times. In drawing 4, 401 is a reflector and 402 is a receiver. The evaluation result is shown in Table 1.
[0079][Working example 3] It carried out like working example 1 except having changed the sealing agent outer layer into the polychlorotrifluoroethylene resin film (50 micrometers in thickness) from white sheet glass. The evaluation result is shown in Table 1.
[0080][Working example 4] It carried out like working example 1 except not using a sealing agent outer layer. The evaluation result is shown in Table 1.
[0081][Comparative example 1] It carried out like working example 1 except not performing closure by a sealing agent. The evaluation result is shown in Table 1.
[0082]
[Table 1]

	屋外暴露		高温高湿試験
	温度(℃)	変換効率（相対値）	
実施例1	90	0.86	○
実施例2	90	0.86	○
実施例3	85	0.87	○
実施例4	80	0.88	△
比較例1	120	0.81	×

[0083]The solar cell module of this invention has few rises in heat, and it is possible to suppress decline in conversion efficiency so that clearly from Table 1. It became possible by closing a photovoltaic cell with a thermally conductive sealing agent to improve the reliability of a photovoltaic cell.
[0084]

[Effect of the Invention]As explained above, according to the solar cell module of this invention, the photovoltaic cell in a condensed type solar cell module is closed with a thermally conductive sealing agent, By emitting the heat of a photovoltaic cell to other members or atmospheres via this sealing agent, it becomes possible to prevent the rise in heat of a photovoltaic cell and to prevent decline in conversion efficiency.

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TECHNICAL FIELD

[Field of the Invention]This invention relates to the condensed type solar cell module which follows the sun, irradiates a photovoltaic cell with the sunlight which condensed, and obtains electric power, and relates to the solar cell module which suppressed the rise in heat of the photovoltaic cell by receiving the light which condensed in detail.

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PRIOR ART

[Description of the Prior Art]A solar cell module can be classified into two kinds according to the method of receiving sunrays in a photovoltaic cell. That is, there are a solar cell module which receives sunrays by a photovoltaic cell as it is, and a condensed type solar cell module which condenses sunrays and receives light by a photovoltaic cell. A solar cell module may make the sun follow a solar cell module, in order to receive sunrays more efficiently, when a stand is fixed.
[0003]Conversion efficiency increases by condensing and a condensed type solar cell module has the merit that area of a photovoltaic cell can be made small. The output current of a photovoltaic cell increases in proportion to condensing magnification. in addition -- following output voltage on the increase in the output current by condensing theoretically -- logarithm -- it increases-like. Therefore, only the increment of light conversion efficiency of output voltage improves by making condensing magnification increase. Since the size of a photovoltaic cell becomes small in inverse proportion to condensing magnification in order to obtain the same output, the cost which a photovoltaic cell occupies in a module is reducible. Then, sunrays are condensed and the solar cell module of the type which follows the sun attracts attention these days.
[0004]**** [a rise of temperature / produce / on the other hand, / a photovoltaic cell / decline in conversion efficiency] Since the sunrays which condensed to the photovoltaic cell are irradiated with a condensed type solar cell module, compared with the usual solar cell module, its rise of the temperature of a photovoltaic cell is remarkable. When it is considered especially as 200 or more-time condensing magnification, a photovoltaic cell becomes an elevated temperature dramatically.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, according to the solar cell module of this invention, the photovoltaic cell in a condensed type solar cell module is closed with a thermally conductive sealing agent, By emitting the heat of a photovoltaic cell to other members or atmospheres via this sealing agent, it becomes possible to prevent the rise in heat of a photovoltaic cell and to prevent decline in conversion efficiency.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]In order to prevent decline in the conversion efficiency by the rise in heat of such a photovoltaic cell, improving the heat dissipation nature of a photovoltaic cell was proposed variously, but SUBJECT which is mentioned later, respectively occurred.
[0006]For example, providing the electrode which is from the good thermal conductivity metallic material which has rugged structure on a light incidence face side in JP,H6-45623,A, and also providing unevenness on the surface of a photovoltaic cell is proposed. Surface area is increased by giving rugged structure, a touch area with the atmosphere etc. is extended, and heat is effectively emitted to the exterior.
[0007]However, a photovoltaic cell is usually used, closing it with a sealing agent, in order to protect this element from moisture or external power. Therefore, although the surface of a photovoltaic cell will contact a sealing agent and heat will move to a sealing agent, the usual sealing agent has low thermal conductivity, and there are few radiation effects.
[0008]The electrode formed in the acceptance surface of a photovoltaic cell is extended to the acceptance surface exterior, and the solar cell module which has a means to cool to the extension is proposed by JP,H11-8401,A. This prevents the thickness of a solar cell module becoming thick by providing a cooling method in the rear-face side of a photovoltaic cell.
[0009]However, since the electrode is provided in the acceptance surface side like the above-mentioned example of precedence, the portion to which light does not strike upon a photovoltaic cell by this electrode will arise. A temperature gradient may produce it on a photovoltaic cell this not only cannot use sunrays effectively, but, and a photovoltaic cell may break. In the case of a condensed type solar cell module, the possibility is especially high.
[0010]Furthermore, a heat sink is pasted together to the rear face of a photovoltaic cell, and the solar cell module which cools a photovoltaic cell is proposed by JP,2000-68539,A. This cools a photovoltaic cell from the rear-face side.

[0011]However, when closing to a photovoltaic cell in the case of such cooling structure, a temperature gradient will arise in the surface [of a photovoltaic cell], and rear-face side. Such a temperature gradient may produce distortion in a photovoltaic cell, and a photovoltaic cell may break.

[0012]And the optoelectric transducer which provides the film of infrared reflexibility and/or infrared absorption nature in the optical input side of an optoelectric transducer is proposed by JP,H10-190017,A. This intercepts the light of the portion used as heat, and prevents the rise in heat of an optoelectric transducer.

[0013]However, although it is possible to prevent the rise in heat of an optoelectric transducer in this case, a photovoltaic cell has sensitivity in the light of an infrared portion in many cases, and has a possibility of causing decline in conversion efficiency.

[0014]Then, an object of this invention is to provide the solar cell module which can prevent conversion efficiency from being able to prevent decline in the conversion efficiency by the rise in heat of a photovoltaic cell, and the photovoltaic cell of a high condensing type solar cell module carrying out a rise in heat especially in light of the above-mentioned problems, and falling.

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MEANS

[Means for Solving the Problem]That the above-mentioned purpose should be attained a solar cell module of this invention, In a solar cell module which has a condensing means which condenses sunrays, and a tailing means to follow the sun, receives sunrays which condensed by a photovoltaic cell, and obtains an output, A photovoltaic cell is closed with a thermally conductive sealing agent, and heat of a photovoltaic cell is emitted to other members or atmospheres via this sealing agent.
[0016]According to the solar cell module of this invention, it becomes possible to prevent a rise in heat of a photovoltaic cell and to prevent decline in conversion efficiency.In a solar cell module of this invention, it is preferred that the surface of the above-mentioned sealing agent has unevenness. Thereby, especially heat dissipation nature to the atmosphere can be made to improve.
[0017]It is preferred that the above-mentioned sealing agent consists of a sealing agent outer layer and a sealing agent inner layer. Thereby, a function, for example, weatherability, and moisture vapor transmission of a sealing agent can be made to improve.
[0018]As for the above-mentioned sealing agent outer layer, it is preferred that moisture vapor transmission is lower than the above-mentioned sealing agent inner layer. The above-mentioned moisture vapor transmission can be made to improve thereby especially.
[0019]And it is preferred that an antireflection film is provided in the above-mentioned sealing agent outer layer. Thereby, an output can be made to improve.
[0020]As for the above-mentioned sealing agent, it is preferred to contain a filler. Heat conduction through a sealing agent can be performed more promptly by this, and a coefficient of linear expansion of sealing resin can be brought close to a coefficient of linear expansion of a photovoltaic cell, and the possibility of exfoliation by a temperature change etc. can be reduced, and a mechanical strength of sealing resin can be made to improve.
[0021]It is preferred that thermal conductivity of the above-mentioned filler is higher than

thermal conductivity of a photovoltaic cell, and it is preferred that it is especially more than 150W/m and K. Thereby, thermal conductivity from a photovoltaic cell to a sealing agent becomes good. [0022]In addition, it is preferred to come to choose the above-mentioned filler from alumimium nitride, magnesium oxide, or beryllium oxide at least. Thereby, the degree of mixture of light can be made to rise. [0023]As for the above-mentioned photovoltaic cell, it is preferred to have an output extraction electrode in the non-acceptance surface side. This becomes possible to prevent a loss of an output by a shadow of an electrode. [0024]As for the above-mentioned condensing means, it is preferred to use a Fresnel lens. Thereby, a condensing means can be miniaturized. [0025]

[Embodiment of the Invention]Although the suitable embodiment of this invention is described hereafter, this invention is not limited to this embodiment.

[0026]The solar cell module of this invention serves as a condensing member which condenses sunrays from the receiver which changes the condensed light into electric power. In them, it has a means to follow the sun.

[0027]Drawing 1 is a schematic diagram showing a receiver's composition in the solar cell module of this invention. As for a sealing agent and 102, in drawing 1, a substrate and 104 are cooling members a photovoltaic cell and 103 101. The sealing agent 101 may be divided into the outer layer 105 of a sealing agent, and the inner layer 106 of the sealing agent.

[0028]The sealing agent 101 is extended outside the circumference of the photovoltaic cell 102, and is contacted in substrate 103 grade. Thereby, the heat transfer not only to the heat dissipation to the atmosphere but other members can be used now.

[0029](Sealing agent) The sealing agent 101 protects the photovoltaic cell 102 from light, moisture, external force, etc. The electrical link portion of the photovoltaic cell 102 and the substrate 103 is also protected from moisture etc. As the characteristic for which the sealing agent 101 is asked, it excels in thermal conductivity, lightfastness, heat resistance, and moisture resistance, and the transmissivity of light is high, and it is excelling in adhesion with a photovoltaic cell etc. When the characteristic independently mentioned above cannot be filled, it is also possible to use two or more layers of the sealing agent outer layer 105 and sealing agent inner layer 106 grade.

[0030]<Thermal conductivity> The thermal conductivity for which the sealing agent 101 in this invention is asked is carrying out heat transfer of the heat of the photovoltaic cell 102 to the atmosphere or other members promptly. Therefore, as for the sealing agent 101, it is preferred that thermal conductivity is high. When silicone resin is used for the sealing agent 101, thermal conductivity is 0.1 - 0.3 W/m-K, but it is possible by mixing a filler to raise even for example, 1.7W/m and K.

[0031]<Lightfastness> The lightfastness for which the sealing agent 101 is asked is hard to deteriorate by the sunrays which condensed. Degradation as used in the field of this invention

means the fall of transparency, the fall of adhesion, the fall of a mechanical strength, etc. The tolerance over the ultraviolet rays which increased intensity especially by condensing is needed. When the lightfastness of sealing resin itself is insufficient, an ultraviolet ray absorbent etc. are added or an ultraviolet absorption film is provided.

[0032]On the other hand, since it protects these members itself from ultraviolet rays when a condensing member is a Fresnel lens which consists of an acrylic resin, polycarbonate resin, etc., and in being the reflector which gave vacuum evaporation of aluminum or silver to the same resin, it may have a function which absorbs ultraviolet rays. In such a case, there is no necessity of providing addition of an ultraviolet ray absorbent and an ultraviolet absorption film.

[0033]<Heat resistance> Are the heat by receiving the light which condensed and the heat resistance for which the sealing agent 101 is asked is hard to deteriorate. Degradation as used in the field of this invention like lightfastness says the fall of transparency, the fall of adhesion, the fall of a mechanical strength, etc. To especially heat, creep resistance is needed. Usually, although the receiver of a condensed type solar cell module cools with the surface and the rear face, temperature will be 50 thru/or about 100 **. A receiver becomes various angles when a solar cell module follows the sun. Therefore, it is not necessary to carry out creep of the sealing agent at the above-mentioned temperature.

[0034]In order to improve creep resistance, it is possible to stop mobility according to bridge construction, when the melting point is low, and to improve opposite creeping property using material with the high melting point. Although it is usable in a method publicly known as the method of bridge construction of a sealing agent, bridge construction of the process which gas does not generate is more preferred. For example, in bridge construction of silicone rubber, what is depended on the addition reaction using the catalyst of a platinum compound etc. which uses a peroxide, the thing to depend on the condensation reaction by heating, the thing to depend on the condensation reaction which uses a catalyst and moisture, the thing to depend on UV irradiation, etc. are mentioned, but. There is no by-product according [what is depended on the addition reaction using the catalyst of a platinum compound etc.] to a reaction, and it is desirable. When making especially silicone resin into a sealing agent inner layer and using the low thing of permeability, such as glass, for a sealing agent outer layer, by producing a by-product, in a sealing agent, the cellular remainder etc. may occur and a receiver's reliability may be spoiled.

[0035]In order to prevent oxidation by heat, an antioxidant may be added to the sealing agent 101.

[0036]<Moisture resistance> The moisture resistance for which the sealing agent 101 is asked is hard to deteriorate with moisture etc. In order to protect the photovoltaic cell 102 from moisture, it is preferred that moisture vapor transmission is low. When independent moisture

vapor transmission is insufficient, it is also possible to adopt composition of two or more layers, such as a sealing agent outer layer and a sealing agent inner layer, and to use for a sealing agent outer layer what has the low moisture vapor transmission of glass etc.

[0037]<Translucency> Although the translucency for which the sealing agent 101 is asked changes with photovoltaic cells 102 to be used, it is preferred to have the transmissivity of not less than 90% in the wavelength of 300 nm - 1000 nm. However, in order to raise the lightfastness of the sealing agent 101, it is unavoidable to make light of 400 nm or less hard to penetrate. An antireflection film may be provided in order to raise transmissivity.

[0038]<Adhesion> The adhesion for which the sealing agent 101 is asked needs for adhesion with the photovoltaic cell 102 and the substrate 103 to be good. When a sealing agent is constituted by the sealing agent inner layer 106 and the sealing agent outer layer 105, it is required for adhesion mutual [these] to be also good. In order to improve adhesion, the bonding assistant which improves adhesion, such as a silane coupling agent, to the sealing agent 101 may be mixed. Processing which raises adhesive strength to the photovoltaic cell 102, the substrate 103, and the adhesion side of the outer layer 105 may be performed.

[0039]The sealing agent 101 which fills the above characteristics is the two-layer composition of the sealing agent outer layer 105 and the sealing agent inner layer 106, for example, and what contains a filler in the sealing agent inner layer 106 is mentioned. A concrete material in such composition is shown below.

[0040](Sealing agent outer layer) Glass, a resin film, etc. are mentioned as the sealing agent outer layer 105 which fills the above-mentioned characteristic. Glass is effective in order to stop moisture vapor transmission low especially. On the other hand, although an acrylic, polyester, a fluoro-resin, etc. are mentioned as a resin film, a fluoro-resin is suitably used lightfastness and in respect of heat resistance. The refractive index of a fluoro-resin is low and it is effective also from a viewpoint of suppressing reflection. As such a fluoro-resin, a tetrafluoroethylene hexafluoropropylene copolymer, A tetrafluoroethylene perfluoroalkyl vinyl ether copolymer, polychlorotrifluoroethylene resin, polyvinylidene fluoride, polyvinyl fluoride, an ethylene-tetrafluoroethylene copolymer, and an ethylene-chlorotrifluoroethylene copolymer are mentioned. Especially polychlorotrifluoroethylene resin has low moisture vapor transmission, and is used suitably. As for these, it is preferred to process to the field which touches a sealing agent inner layer in order to raise adhesion with the sealing agent inner layer 106. For example, it is preferred to perform corona discharge treatment, plasma discharge processing, ozonization, or coating of a primer.

[0041]In these sealing agent outer layer 105, it is preferred that it is uneven. It is possible to use the method of it being uneven beforehand and also transferring unevenness in a sealing process.

[0042]When the refractive index is high, it is also possible to provide an antireflection film. For

example, vapor-depositing MgF etc. or applying the paint of a fluoro-resin system etc. is mentioned.

[0043](Sealing agent inner layer) Silicone resin, a fluoro-resin, etc. are mentioned as the sealing agent inner layer 106 which fills the above-mentioned characteristic. Especially in the method of hardening liquefied silicone resin and using, a process is easy and mixing of a filler, etc. can be performed easily.

[0044](Filler) As stated previously, when the sealing agent 101 generally consists of resin, in the case of silicone resin, the thermal conductivity of the resin is about 0.1-0.3 W/m-K. It is possible by mixing a filler to make it improve to for example, 1.7 W/m-K. In this invention, fillers are the particles of the inorganic compound of a grain, fibrous, tabular, or amorphous state.

[0045]As a filler used suitably for this invention, An aluminum oxide (thermal conductivity 17 W/m-K), silicon carbide (thermal conductivity 42 W/m-K), Silicon nitride (thermal conductivity 21 W/m-K), magnesium oxide (thermal conductivity 419 W/m-K), Although inorganic compounds, such as boron nitride (the thermal conductivity 1300 - 30 W/m-K), alumimium nitride (thermal conductivity/mof 170W andK), beryllium oxide (thermal conductivity 230 W/m-K), glass (thermal conductivity 1.2 W/m-K), and silica (thermal conductivity 0.5 W/m-K), are mentioned, Of course, it is not necessarily limited to these.

[0046]In a condensed type solar cell module, what can make the degree of mixture high is preferred, and an aluminum oxide, silicon carbide, silicon nitride, magnesium oxide, boron nitride, and alumimium nitride are more preferred.

[0047]When thermal conductivity is 150 or more W/m-K, the radiation effect of sealing resin increases greatly and inorganic compounds, such as thermally conductive, comparatively big alumimium nitride, magnesium oxide, and beryllium oxide, are chosen preferably especially. As for the particle diameter, it is preferred that they are 0.1 micrometer thru/or 100 micrometers as concrete particle diameter.

[0048]In the case of a condensed type solar cell module, the high degree of mixture of the condensed light is required. Because, when the degree of mixture is low, a portion with it and a small portion will exist in the surface of the photovoltaic cell 102, the temperature of the photovoltaic cell 102 goes up rapidly in a big portion with extraordinary light intensity, and the photovoltaic cell 102 may be destroyed. [remarkable light intensity and] [big] In this invention, the thermal conductivity of beryllium oxide, alumimium nitride, magnesium oxide, etc. is very high, and it is effective in raising the degree of mixture of light by using what has light reflex nature.

[0049]As for points, such as a mechanical strength of sealing resin, to the mixed amount, it is preferred that it is 10 thru/or 50 volume %. In the case of silicone resin, the tensile strength of silicone resin becomes with the maximum within the limits of this. On the other hand, from a thermally conductive point, it is preferred that it is 30 thru/or 80 volume %. As for the mixed

amount of the above thing to a filler, it is preferred that it is 30 thru/or 50 volume %.
[0050]In order to heighten adhesive strength with sealing resin, a surface treatment may be performed to a filler. For example, it processes by finishing agents, such as the Silang system, a titanate system, and an aluminate system. As the method of processing, the method of processing a filler beforehand, the method of mixing the processing agent to sealing resin, etc. are mentioned.
[0051]These fillers may mix what may use it, mixing two or more kinds, and has two or more kinds of particle diameter.
[0052](Photovoltaic cell) As the photovoltaic cell 102 used suitably for this invention, compound semiconductor systems, such as a crystalline silicon system (thermal conductivity 140 W/m-K), GaAs (thermal conductivity 54 W/m-K), CdTe, CdS, and CIS (CuInSe), etc. are mentioned. As for the electrode which takes out the output of the photovoltaic cell 102, in order to lose the loss of the incident light by the shadow of an electrode, it is preferred to be formed in the rear face of the photovoltaic cell 102. In order to use incident light effectively, it is preferred to form texture structure in the surface of the photovoltaic cell 102.
[0053](Substrate) What consists of a conductive member electrically connected with the photovoltaic cell 102 as the substrate 103 used for this invention and an insulating member which insulates the photovoltaic cell 102 and the cooling member 104 is mentioned. It electrically connects with the electrode of + and - which are output extraction of the photovoltaic cell 102, respectively, and a conductive member is outputted to the exterior.
[0054]The above-mentioned conductive member and the connection of an electrode can use solder, conductive adhesives, etc. The adhesion of an above-mentioned conductive member and insulation member can be [using what pasted the conductive member together to the insulation member beforehand] possible, and can also paste an insulating member together with adhesives etc. after adhesion of the photovoltaic cell 102 and a conductive member. Adhesion of the substrate 103 and the cooling member 104 is also the same.
[0055]As the above-mentioned conductive member, resistance is low, thermal conductivity is high, and it is preferred that it is stable to moisture etc. Copper etc. are mentioned as a concrete material.
[0056]It is called for that insulation is high and thermal conductivity is high as the above-mentioned insulation member. Alumimium nitride, an aluminum oxide, etc. are mentioned as a concrete material.
[0057]As the substrate 103 suitably used in this invention, the laminated circuit board of copper / alumimium nitride / copper, and copper / aluminum oxide / copper, etc. are mentioned.
[0058](Cooling member) The cooling member 104 used for this invention is for preventing the rise in heat of the photovoltaic cell 102. As a cooling method, although water cooling, air

cooling, etc. are mentioned, it is also possible to use thermoelements, such as a Peltier device.

[0059](Condensing member) In this invention, it is [means / to condense] usable in a publicly known method. For example, the method of using a Fresnel lens, the method of using a light reflector, etc. are mentioned.
[0060](Tracking apparatus) In this invention, it is [means / to follow the sun] usable in a publicly known method.

[Translation done.]

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EXAMPLE

[Example]Hereafter, although this invention is explained in detail based on working example, this invention is not limited to these working example.
[0062][Working example 1] In this example, in order to assemble an evaluation module, the receiver of composition of being shown in drawing 2 was created.
[0063]First, as a receiver's members forming, as shown in drawing 2, the sealing agent outer layer 201, the sealing agent inner layer 202, the photovoltaic cell 203, the substrate 204, and the cooling member 205 were prepared.
[0064](Sealing agent outer layer) As the sealing agent outer layer 201, white sheet glass (1-mm thickness) was prepared.
[0065](Creation of a sealing agent inner layer) Aluminum oxide (mean particle diameter of 1 micrometer) 240 weight section was prepared as a filler with 2 liquid addition type liquid silicone 100 weight section as the sealing agent inner layer 202. The above was mixed and deaerated.
[0066](Photovoltaic cell) The photovoltaic cell of single crystal silicon was prepared as the photovoltaic cell 203.
[0067](Substrate) As the substrate 204, the substrate of the three-layer laminated structure of copper / alumimium nitride / copper was prepared.
[0068](Cooling member) The heat sink was prepared as the cooling member 205.
[0069]The above member was assembled by the following methods.
[0070]Soldering paste was printed to the position on the substrate 204, and the photovoltaic cell 203 was laid in the position. The reflow furnace was used, this was heated and cooled and the substrate 204 and the photovoltaic cell 203 were unified.
[0071]Next, the adhesives of heat-conducting characteristic were applied to the cooling member 205, it pasted together to what unified the substrate 204 and the photovoltaic cell 203, and heat cure was carried out with the hot air drying furnace.

[0072]Finally, the sealing agent inner layer 202 was dropped on the photovoltaic cell 203, the sealing agent outer layer 201 was carried on it, and it put into the vacuum chamber, and deaerated again. Then, heat cure was carried out with the hot air drying furnace.
[0073]Next, the receiver's electrical property at 25 ** was measured using the simulator.
[0074]The obtained receiver was set to the condensing system using the Fresnel lens shown in drawing 3, and the solar cell module was assembled. Condensing magnification was made into 250 times. As for 301, in drawing 3, a case and 303 are receivers a Fresnel lens and 302.
[0075]And the following techniques estimated the obtained solar cell module.
[0076](Outdoor exposure test) It installed in the solar tracking apparatus which does not illustrate the obtained solar cell module, the outdoor exposure was performed, and the temperature of a photovoltaic cell and the conversion efficiency of the solar cell module were measured there. It is shown in Table 1 as a relative value over the value which measured the measurement result of this conversion efficiency using the simulator beforehand.
[0077](High-humidity/temperature examination) After doing the high-humidity/temperature examination of 85 **, 85%, and 5000 hours for the obtained receiver, conversion efficiency was measured like the above-mentioned outdoor exposure test. Viewing estimated appearance. The following valuation bases estimate and the result is shown in Table 1.
O : -- what produced the thing x:exfoliation etc. which did not produce change in appearance, and did not produce change in the thing **:appearance which does not produce not less than 3% of fall in conversion efficiency, but produced 5% or less of fall not less than 3% in conversion efficiency [0078][Working example 2] The receiver was created like working example 1. The obtained receiver was set to the solar cell module using the reflector shown in drawing 4. Condensing magnification was made into 250 times. In drawing 4, 401 is a reflector and 402 is a receiver. The evaluation result is shown in Table 1.
[0079][Working example 3] It carried out like working example 1 except having changed the sealing agent outer layer into the polychlorotrifluoroethylene resin film (50 micrometers in thickness) from white sheet glass. The evaluation result is shown in Table 1.
[0080][Working example 4] It carried out like working example 1 except not using a sealing agent outer layer. The evaluation result is shown in Table 1.
[0081][Comparative example 1] It carried out like working example 1 except not performing closure by a sealing agent. The evaluation result is shown in Table 1.
[0082]
[Table 1]

	屋外暴露		高温高湿試験
	温度(℃)	変換効率（相対値）	
実施例1	90	0.86	○
実施例2	90	0.86	○
実施例3	85	0.87	○
実施例4	80	0.88	△
比較例1	120	0.81	×

[0083]The solar cell module of this invention has few rises in heat, and it is possible to suppress decline in conversion efficiency so that clearly from Table 1. It became possible by closing a photovoltaic cell with a thermally conductive sealing agent to improve the reliability of a photovoltaic cell.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a schematic diagram showing a receiver's laminated constitution in the solar cell module of this invention.
[Drawing 2]It is a schematic diagram showing a receiver's laminated constitution in the solar cell module concerning working example.
[Drawing 3]It is a schematic diagram showing the structure of the solar cell module concerning working example and a comparative example.
[Drawing 4]It is a schematic diagram showing the structure of the solar cell module concerning working example 2.
[Description of Notations]
101 Sealing agent
102 Photovoltaic cell
103 Substrate
104 Cooling member
105 Sealing agent outer layer
106 Sealing agent inner layer
201 Sealing agent outer layer
202 Sealing agent inner layer
203 Photovoltaic cell
204 Substrate
205 Cooling member
301 Fresnel lens
302 Case
303 Receiver
401 Reflector

402 Receiver

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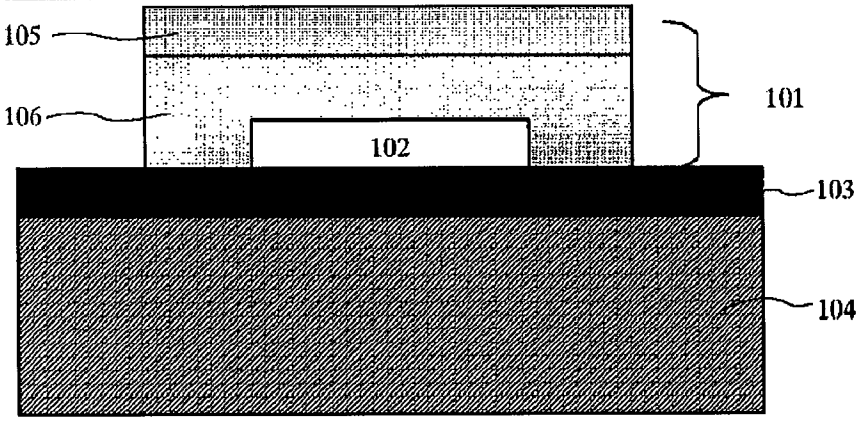
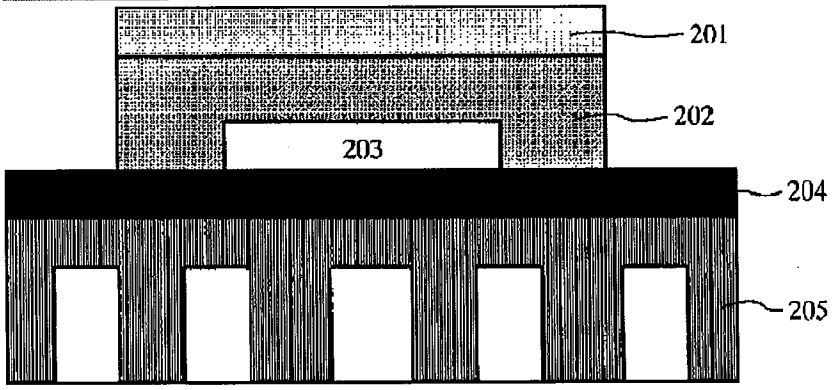
DRAWINGS

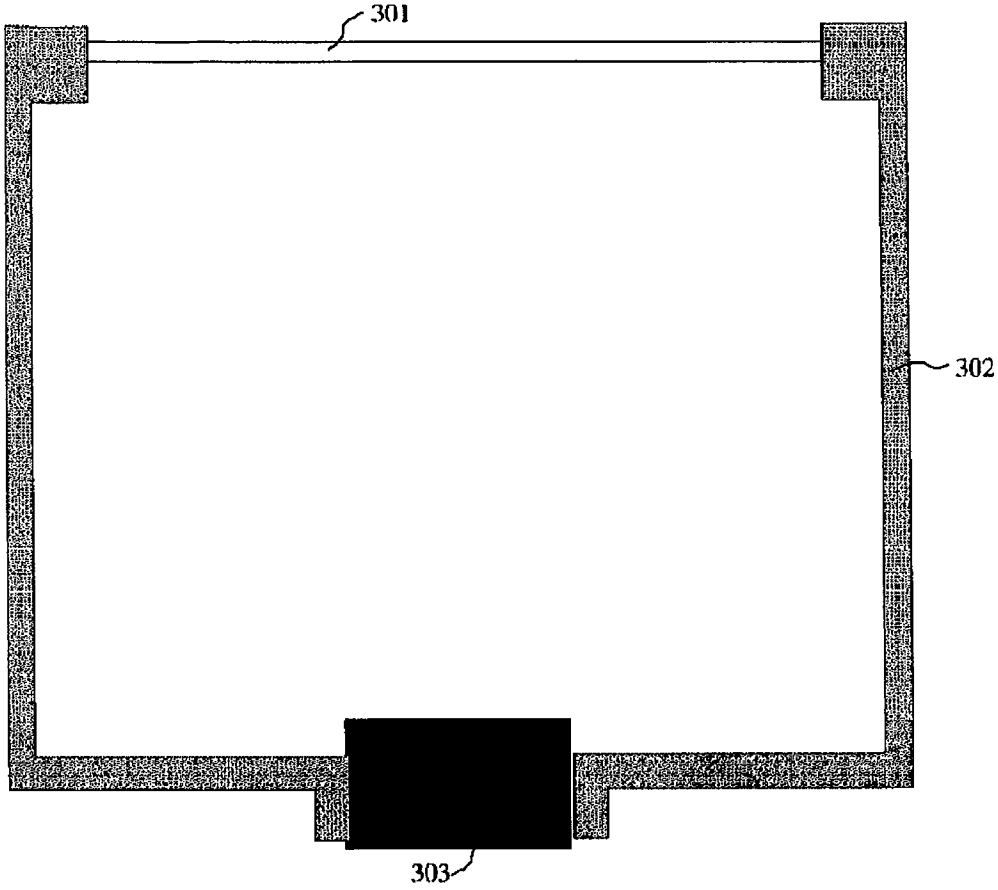
[Drawing 1]



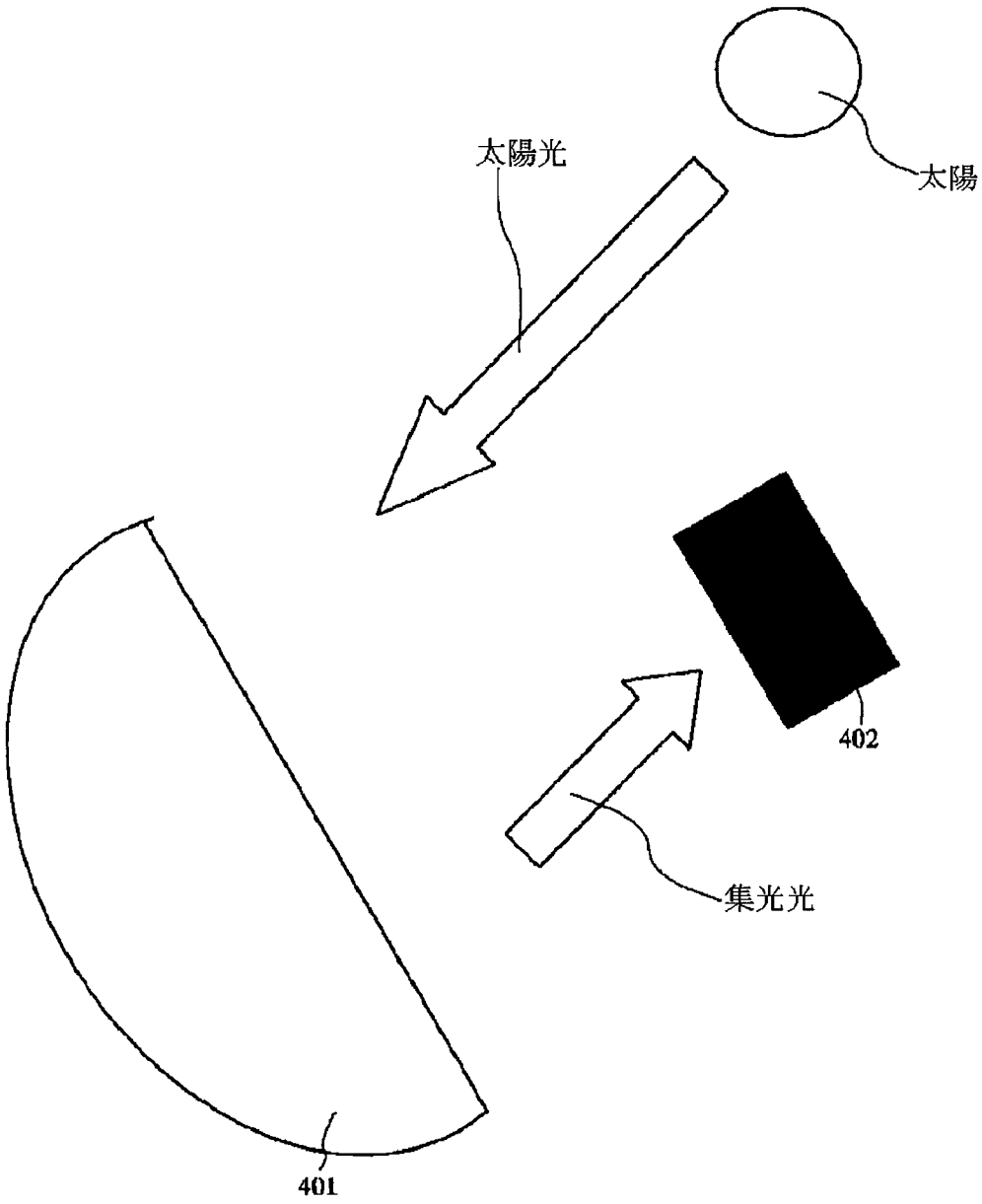
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]

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審査請求　未請求　請求項の数11　ＯＬ　（全　９　頁）

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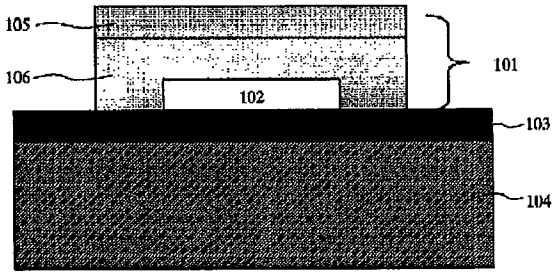
Ｆターム(参考)　5F051 AA02 BA11 BA18 JA03 JA04 JA10 JA13 JA14

(54)【発明の名称】　太陽電池モジュール

(57)【要約】
【課題】　光起電力素子の温度上昇による変換効率の低下を防止することができ、特に高集光型の太陽電池モジュールにおける光起電力素子が温度上昇して変換効率が低下するのを防止することができる太陽電池モジュールを提供する。
【解決手段】　集光型の太陽電池モジュールにおける光起電力素子１０２を熱伝導性封止材１０１で封止し、この封止材１０１を介して光起電力素子１０２の熱を他の部材もしくは大気に放出する。



【特許請求の範囲】
【請求項１】　太陽光線を集光する集光手段と太陽を追尾する追尾手段とを有し、集光した太陽光線を光起電力素子で受光して出力を得る太陽電池モジュールにおいて、
前記光起電力素子を熱伝導性封止材で封止し、該封止材を介して前記光起電力素子の熱を他の部材もしくは大気に放出することを特徴とする太陽電池モジュール。
【請求項２】　前記封止材の表面が凹凸を有することを特徴とする請求項１に記載の太陽電池モジュール。
【請求項３】　前記封止材が、封止材外層と封止材内層とからなることを特徴とする請求項１または２に記載の太陽電池モジュール。
【請求項４】　前記封止材外層は、前記封止材内層よりも水蒸気透過率が低いことを特徴とする請求項３に記載の太陽電池モジュール。
【請求項５】　前記封止材外層には、反射防止膜が設けられていることを特徴とする請求項３または４に記載の太陽電池モジュール。
【請求項６】　前記封止材はフィラーを含有していることを特徴とする請求項１乃至５のいずれかに記載の太陽電池モジュール。
【請求項７】　前記フィラーの熱伝導率が、光起電力素子の熱伝導率よりも高いことを特徴とする請求項６に記載の太陽電池モジュール。
【請求項８】　前記フィラーの熱伝導率が１５０Ｗ／ｍ・Ｋ以上であることを特徴とする請求項６または７に記載の太陽電池モジュール。
【請求項９】　前記フィラーが少なくとも窒化アルミニウム、酸化マグネシウム、酸化ベリリウムのいずれかから選択されてなることを特徴とする請求項６乃至８のいずれかに記載の太陽電池モジュール。
【請求項１０】　前記光起電力素子は、非受光面側に出力取り出し電極を有することを特徴とする請求項１乃至９のいずれかに記載の太陽電池モジュール。
【請求項１１】　前記集光手段は、フレネルレンズを用いたものであることを特徴とする請求項１乃至１０のいずれかに記載の太陽電池モジュール。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、太陽を追尾し、集光した太陽光を光起電力素子に照射して電力を得る集光型の太陽電池モジュールに係り、詳しくは、集光した光を受光することによる光起電力素子の温度上昇を抑えた太陽電池モジュールに関する。
【０００２】
【従来の技術】太陽電池モジュールは、光起電力素子に太陽光線を受ける方法により２種類に分類できる。すなわち、太陽光線をそのまま光起電力素子で受光する太陽電池モジュールと、太陽光線を集光して光起電力素子で受光する集光型の太陽電池モジュールとがある。更に、太陽電池モジュールは架台を固定する場合と、太陽光線をより効率良く受光するために、太陽電池モジュールを太陽に追尾させる場合とがある。
【０００３】集光型の太陽電池モジュールは、集光により変換効率が高まり、光起電力素子の面積を小さくできるというメリットがある。光起電力素子の出力電流は、集光倍率に比例して増加する。これに加えて出力電圧は、原理的に集光による出力電流の増加に伴って対数的に増大する。したがって光変換効率は、集光倍率を増加させることにより出力電圧の増加分だけ向上する。また同一の出力を得るためには、光起電力素子の寸法が集光倍率に反比例して小さくなるため、モジュールの中で光起電力素子の占めるコストを削減することができる。そこで最近、太陽光線を集光し、太陽を追尾するタイプの太陽電池モジュールが注目されている。
【０００４】一方、光起電力素子は温度が上昇すると変換効率の低下を生じる。集光型の太陽電池モジュールは光起電力素子に集光した太陽光線が照射されるため、通常の太陽電池モジュールに比べて、光起電力素子の温度の上昇が顕著である。特に集光倍率を２００倍以上とした場合には、光起電力素子は非常に高温になる。
【０００５】
【発明が解決しようとする課題】このような光起電力素子の温度上昇による変換効率の低下を防ぐために、光起電力素子の放熱性を高めることが種々提案されているが、それぞれ後述するような課題があった。
【０００６】例えば特開平６－４５６２３号公報には、光入射面側に凹凸構造を有する良熱伝導性の金属材料からなる電極を設け、更に光起電力素子の表面に凹凸を設けることが提案されている。凹凸構造をもたせることで表面積を増大させ、大気等との接触面積を広げて熱を効果的に外部へ放出するものである。
【０００７】しかし通常、光起電力素子は、該素子を水分や外的な力から保護するため、封止材により封止して使用される。そのため、光起電力素子の表面は封止材と接触することとなり、熱は封止材へと移動することとなるが、通常の封止材は熱伝導率が低く、放熱効果は少ない。
【０００８】また特開平１１－８４０１号公報には、光起電力素子の受光面に形成された電極を受光面外部に延長し、その延長部に冷却する手段を有する太陽電池モジュールが提案されている。これは、光起電力素子の裏面側に冷却手段を設けることにより太陽電池モジュールの厚みが厚くなることを防ぐものである。
【０００９】しかし、前述の先行例と同様に受光面側に電極を設けているので、該電極により光起電力素子に光があたらない部分が生じてしまう。これは、太陽光線を有効に利用しえないだけでなく、光起電力素子上に温度差が生じ、光起電力素子が壊れてしまう可能性もある。

特に集光型の太陽電池モジュールの場合には、その可能性が高い。

【００１０】さらに特開２０００－６８５３９号公報には、光起電力素子の裏面にヒートシンクを貼り合わせて、光起電力素子を冷却する太陽電池モジュールが提案されている。これは光起電力素子を裏面側から冷却するものである。

【００１１】しかし、このような冷却構造の場合、光起電力素子に封止を施した際に、光起電力素子の表面側と裏面側に温度差が生じてしまう。このような温度差は光起電力素子に歪を生じる場合があり、光起電力素子が壊れてしまう場合がある。

【００１２】そして特開平１０－１９００１７号公報には、光電変換素子の光入力側に赤外線反射性および／または赤外線吸収性の膜を設ける光電変換素子が提案されている。これは熱となる部分の光を遮断して、光電変換素子の温度上昇を防ぐものである。

【００１３】しかし、この場合光電変換素子の温度上昇を防ぐことは可能であるが、光起電力素子は赤外部分の光に感度を有する場合が多く、変換効率の低下を招く虞れがある。

【００１４】そこで本発明は、上記課題に鑑みて、光起電力素子の温度上昇による変換効率の低下を防止することができ、特に高集光型の太陽電池モジュールの光起電力素子が温度上昇して変換効率が低下するのを防止することができる太陽電池モジュールを提供することを目的とする。

【００１５】

【課題を解決するための手段】上記の目的を達成すべく、本発明の太陽電池モジュールは、太陽光線を集光する集光手段と太陽を追尾する追尾手段とを有し、集光した太陽光線を光起電力素子で受光して出力を得る太陽電池モジュールにおいて、光起電力素子を熱伝導性封止材で封止し、該封止材を介して光起電力素子の熱を他の部材もしくは大気に放出することを特徴とする。

【００１６】本発明の太陽電池モジュールによれば、光起電力素子の温度上昇を防ぎ、変換効率の低下を防ぐことが可能となる。本発明の太陽電池モジュールにおいては、上記封止材の表面が凹凸を有することが好ましい。これにより、特に大気への放熱性を向上せしめることができる。

【００１７】また、上記封止材が、封止材外層と封止材内層とからなることが好ましい。これにより、封止材の機能、例えば耐候性や透湿度を向上せしめることができる。

【００１８】さらに、上記封止材外層は、上記封止材内層よりも水蒸気透過率が低いことが好ましい。これにより、特に前述の透湿度を向上せしめることができる。

【００１９】そして、上記封止材外層には、反射防止膜が設けられていることが好ましい。これにより、出力を向上せしめることができる。

【００２０】また、上記封止材はフィラーを含有していることが好ましい。これにより、封止材を介しての熱伝導がより速やかに行われ、また、封止樹脂の線膨張係数を光起電力素子の線膨張係数に近づけることができ、温度変化等による剥離の可能性を低減でき、且つ、封止樹脂の機械的強度を向上せしめることができる。

【００２１】さらに、上記フィラーの熱伝導率が、光起電力素子の熱伝導率よりも高いことが好ましく、１５０Ｗ／ｍ・Ｋ以上であることが特に好ましい。これにより、光起電力素子から封止材への熱伝導性が良好となる。

【００２２】加えて、上記フィラーが少なくとも窒化アルミニウム、酸化マグネシウム、酸化ベリリウムのいずれかから選択されてなることが好ましい。これにより、光の混和度を上昇せしめることができる。

【００２３】また、上記光起電力素子は、非受光面側に出力取り出し電極を有することが好ましい。これにより、電極の影による出力のロスを防ぐことが可能となる。

【００２４】上記集光手段は、フレネルレンズを用いたものであることが好ましい。これにより、集光手段を小型化できる。

【００２５】

【発明の実施の形態】以下、本発明の好適な実施の形態を説明するが、本発明は本実施形態に限定されるものではない。

【００２６】本発明の太陽電池モジュールは、太陽光線を集光する集光部材と、集光された光を電力に変換するレシーバーからなる。更に、それらには太陽を追尾する手段を有している。

【００２７】図１は、本発明の太陽電池モジュールにおけるレシーバーの構成を示す概略図である。図１において、１０１は封止材、１０２は光起電力素子、１０３は基板、１０４は冷却部材である。封止材１０１は、封止材の外層１０５と、封止材の内層１０６とに分かれている場合もある。

【００２８】封止材１０１は光起電力素子１０２の周辺よりも外側に延長し、基板１０３等に接触させる。これにより、大気への放熱だけでなく他の部材への伝熱を利用できるようになる。

【００２９】（封止材）封止材１０１は、光起電力素子１０２を光、水分、外力等から保護するものである。更に、光起電力素子１０２と基板１０３との電気的接続部分も水分等から保護する。封止材１０１に求められる特性としては、熱伝導性、耐光性、耐熱性、及び耐湿性に優れ、また光の透過率が高く、光起電力素子との密着性に優れること等である。単独で前述した特性を満たすことができない場合には、封止材外層１０５、封止材内層１０６等の複数層にすることも可能である。

【００３０】〈熱伝導性〉本発明における封止材１０１に求められる熱伝導性は、光起電力素子１０２の熱を速やかに大気または、他の部材へ伝熱させることである。そのため、封止材１０１は熱伝導率が高いことが好ましい。封止材１０１に例えばシリコーン樹脂を用いた場合には熱伝導率は０．１～０．３Ｗ／ｍ・Ｋであるが、フィラーを混合することにより例えば１．７Ｗ／ｍ・Ｋにまで向上させることが可能である。

【００３１】〈耐光性〉封止材１０１に求められる耐光性は、集光した太陽光線によって劣化しにくいことである。本発明でいう劣化とは、透明性の低下、密着性の低下、及び機械的強度の低下等を言う。特に集光により強度を増した紫外線に対する耐性が必要となる。封止樹脂自体の耐光性が不十分である場合には、紫外線吸収剤等を添加したり、紫外線吸収膜を設ける。

【００３２】一方、集光部材が例えば、アクリル樹脂、ポリカーボネート樹脂等からなるフレネルレンズである場合、また同様な樹脂にアルミニウムや銀の蒸着を施した反射鏡である場合には、それら部材自体を紫外線からの保護するため、紫外線を吸収する機能を有している場合がある。そのような場合には紫外線吸収剤の添加、紫外線吸収膜を設ける必要は無い。

【００３３】〈耐熱性〉封止材１０１に求められる耐熱性は、集光した光を受けることによる熱よって劣化しにくいことである。耐光性と同様に本発明でいう劣化とは、透明性の低下、密着性の低下、及び機械的強度の低下等をいう。特に熱に対しては耐クリープ性が必要となる。通常、集光型の太陽電池モジュールのレシーバーは表面及び裏面で冷却を行うが、温度は５０乃至１００℃程度になる。またレシーバーは、太陽電池モジュールが太陽を追尾することにより、さまざまな角度となる。そのため封止材は前述の温度でクリープしない必要がある。

【００３４】耐クリープ性を高めるためには融点の高い材料を用い、融点が低い場合には架橋により流動性を抑え、対クリープ性を高めることが可能である。封止材の架橋の方法としては公知の方法が使用可能であるが、架橋はガスの発生しないプロセスがより好ましい。例えば、シリコーンゴムの架橋の場合には、過酸化物を使用する、白金化合物等の触媒を用いた付加反応によるもの、加熱による縮合反応によるもの、触媒と水分を使用する縮合反応によるもの、ＵＶ照射によるもの等が挙げられるが、白金化合物等の触媒を用いた付加反応によるものが反応による副生成物が無く好ましい。特にシリコーン樹脂を封止材内層とし、封止材外層にガラス等の気体透過性の低いものを用いる場合には、副生成物を生じることにより、封止材中に気泡残り等が発生してレシーバーの信頼性を損なうことがある。

【００３５】また、熱による酸化を防止するために、封止材１０１には酸化防止剤を添加してもよい。

【００３６】〈耐湿性〉封止材１０１に求められる耐湿性は、水分等で劣化しにくいことである。また、光起電力素子１０２を水分から保護するために透湿度が低いことが好ましい。単独での透湿度が不十分な場合には、封止材外層、封止材内層といった複数層の構成を採用し、封止材外層にガラス等の透湿度の低いものを用いることも可能である。

【００３７】〈透光性〉封止材１０１に求められる透光性は、使用する光起電力素子１０２によって異なるが、波長３００ｎｍ～１０００ｎｍにおいて９０％以上の透過率を有することが好ましい。しかし、封止材１０１の耐光性を向上させるために４００ｎｍ以下の光を透過しにくくすることはやむをえない。更に、透過率を向上させるために反射防止膜を設けてもよい。

【００３８】〈密着性〉封止材１０１に求められる密着性は、光起電力素子１０２、基板１０３との密着性が良いことが必要である。また、封止材が封止材内層１０６と封止材外層１０５によって構成される場合には、これら相互の密着性も良いことが必要である。密着性を高めるためには、封止材１０１にシランカップリング剤等の密着性を高める接着助剤を混合してもよい。更に、光起電力素子１０２、基板１０３、外層１０５の接着面に接着力を高める処理を施してもよい。

【００３９】以上のような特性を満たす封止材１０１は、例えば封止材外層１０５、封止材内層１０６の２層構成であり、封止材内層１０６にフィラーを含有するものが挙げられる。以下にこのような構成の場合の具体的な材料について示す。

【００４０】（封止材外層）前述の特性を満たす封止材外層１０５としては、ガラス、樹脂フィルム等が挙げられる。特に、透湿度を低く抑えるためにガラスは有効である。一方樹脂フィルムとしては、アクリル、ポリエステル、フッ素樹脂等が挙げられるが、耐光性、耐熱性の点でフッ素樹脂が好適に用いられる。またフッ素樹脂は、屈折率が低く、反射を抑える観点からも有効である。そうしたフッ素樹脂としては、テトラフルオロエチレン－ヘキサフルオロプロピレン共重合体、テトラフルオロエチレン－パーフルオロアルキルビニルエーテル共重合体、ポリクロロトリフルオロエチレン、ポリフッ化ビニリデン、ポリフッ化ビニル、エチレン－テトラフルオロエチレン共重合体、エチレン－クロロトリフルオロエチレン共重合体が挙げられる。特にポリクロロトリフルオロエチレンは透湿度が低く、好適に用いられる。これらは封止材内層１０６との密着性を向上させるために、封止材内層と接する面に処理を施すことが好ましい。例えば、コロナ放電処理、プラズマ放電処理、オゾン処理、またはプライマーのコーティングを行なうことが好ましい。

【００４１】また、これら封止材外層１０５には、凹凸を施すことが好ましい。予め凹凸を施しておく他に、封

止工程において凹凸を転写する方法を用いることが可能である。

【００４２】さらに、その屈折率が高い場合には反射防止膜を設けることも可能である。例えば、ＭｇＦ等を蒸着したり、フッ素樹脂系の塗料を塗布する等が挙げられる。

【００４３】（封止材内層）前述の特性を満たす封止材内層１０６としては、シリコーン樹脂、フッ素樹脂等が挙げられる。特に、液状のシリコーン樹脂を硬化して用いる方法では、工程が容易であり、またフィラーの混合等も容易に行うことができる。

【００４４】（フィラー）先に述べたように一般的に封止材１０１が樹脂からなる場合には、その樹脂の熱伝導率は、シリコーン樹脂の場合０．１～０．３Ｗ／ｍ・Ｋ程度である。フィラーを混合することにより例えば１．７Ｗ／ｍ・Ｋまで向上させることが可能である。本発明においてフィラーとは、粒状、繊維状、板状または無定形状の無機化合物の粒子である。

【００４５】本発明に好適に用いられるフィラーとしては、酸化アルミニウム（熱伝導率１７Ｗ／ｍ・Ｋ）、炭化ケイ素（熱伝導率４２Ｗ／ｍ・Ｋ）、窒化ケイ素（熱伝導率２１Ｗ／ｍ・Ｋ）、酸化マグネシウム（熱伝導率４１９Ｗ／ｍ・Ｋ）、窒化ホウ素（熱伝導率１３００～３０Ｗ／ｍ・Ｋ）、窒化アルミニウム（熱伝導率１７０Ｗ／ｍ・Ｋ）、酸化ベリリウム（熱伝導率２３０Ｗ／ｍ・Ｋ）、ガラス（熱伝導率１．２Ｗ／ｍ・Ｋ）、シリカ（熱伝導率０．５Ｗ／ｍ・Ｋ）などの無機化合物が挙げられるが、無論これらに限定されるわけではない。

【００４６】また、集光型の太陽電池モジュールにおいては、混和度を高くできるものが好ましく、酸化アルミニウム、炭化ケイ素、窒化ケイ素、酸化マグネシウム、窒化ホウ素、窒化アルミニウムがより好ましい。

【００４７】更に熱伝導率が１５０Ｗ／ｍ・Ｋ以上であることにより、封止樹脂の放熱効果は大きく高まり、中でも熱伝導性の比較的大きな窒化アルミニウム、酸化マグネシウム、酸化ベリリウムなどの無機化合物が好ましく選択される。その粒径は、具体的な粒径としては０．１μｍ乃至１００μｍであることが好ましい。

【００４８】集光型の太陽電池モジュールの場合、集光された光の高い混和度が要求される。なぜならば、混和度が低い場合には、光起電力素子１０２の表面に光強度が著しく大きな部分と、小さな部分が存在することとなり、光強度の非常な大きな部分においては光起電力素子１０２の温度が急激に上がり、光起電力素子１０２が破壊されてしまう場合がある。本発明において、酸化ベリリウム、窒化アルミニウム、酸化マグネシウム等の熱伝導性が極めて高く、かつ光反射性を有するものを使用することで、光の混和度を上げる効果がある。

【００４９】また、封止樹脂の機械的強度等の点から、その混合量は１０乃至５０体積％であることが好ましい。シリコーン樹脂の場合にはこの範囲内でシリコーン樹脂の引っ張り強度は最大となる。一方、熱伝導性の点からは３０乃至８０体積％であることが好ましい。以上のことから、フィラーの混合量は３０乃至５０体積％であることが好ましい。

【００５０】フィラーには、封止樹脂との接着力を高めるために表面処理を施してもよい。例えばシラン系、チタネート系、アルミネート系等の表面処理剤で処理する。処理の方法としては、予めフィラーを処理する方法、封止樹脂に処理剤を混合しておく方法等が挙げられる。

【００５１】これらフィラーは、複数種類混合して使用してもよく、また複数種類の粒径を持つものを混合してもよい。

【００５２】（光起電力素子）本発明に好適に用いられる光起電力素子１０２としては、結晶シリコン系（熱伝導率１４０Ｗ／ｍ・Ｋ）、ＧａＡｓ（熱伝導率５４Ｗ／ｍ・Ｋ）、ＣｄＴｅ、ＣｄＳ、ＣＩＳ（ＣｕＩｎＳｅ）等の化合物半導体系、等が挙げられる。光起電力素子１０２の出力を取り出す電極は、電極の影による入射光のロスを無くすために光起電力素子１０２の裏面に形成されていることが好ましい。また、入射光を有効に利用するために、光起電力素子１０２の表面にテクスチャー構造を形成することが好ましい。

【００５３】（基板）本発明に用いられる基板１０３としては、光起電力素子１０２と電気的に接続される導電性の部材と、光起電力素子１０２と冷却部材１０４を絶縁する絶縁性の部材からなるものが挙げられる。導電性部材は光起電力素子１０２の出力取り出しである、＋及び－の電極とそれぞれ電気的に接続し、外部へと出力する。

【００５４】上記の導電性部材と電極の接続は、半田や、導電性の接着剤等を用いることが可能である。また、上記の導電性部材と絶縁性部材の接着は、予め絶縁性部材に導電性部材を貼り合わせたものを使用することも可能であるが、光起電力素子１０２と導電性部材の接着のあとに、接着剤等で絶縁部材を貼り合わせる事も可能である。基板１０３と冷却部材１０４の接着も同様である。

【００５５】上記の導電性部材としては、抵抗が低く、熱伝導性が高く、水分等に対して安定であることが好ましい。具体的な材料としては、銅等が挙げられる。

【００５６】また、上記の絶縁性部材としては、絶縁性が高く、熱伝導性が高いことが求められる。具体的な材料としては、窒化アルミニウム、酸化アルミニウム等が挙げられる。

【００５７】本発明において好適に用いられる基板１０３としては、銅／窒化アルミニウム／銅、銅／酸化アルミニウム／銅の積層基板等が挙げられる。

【００５８】（冷却部材）本発明に用いられる冷却部材

１０４は、光起電力素子１０２の温度上昇を防ぐためのものである。冷却手段としては、水冷、空冷等が挙げられるが、ペルチェ素子等の熱電素子を用いることも可能である。

【００５９】（集光部材）本発明において、集光する手段は、公知の方法が使用可能である。例えば、フレネルレンズを用いる方法、反射板を用いる方法等が挙げられる。

【００６０】（追尾装置）本発明において、太陽を追尾する手段は、公知の方法が使用可能である。

【００６１】

【実施例】以下、実施例に基づき本発明を詳細に説明するが、本発明はこれらの実施例に限定されるものではない。

【００６２】〔実施例１〕本実施例においては、評価用モジュールを組み立てるために、図２に示す構成のレシーバーを作成した。

【００６３】先ず、レシーバーの構成部材として、図２に示すように、封止材外層２０１、封止材内層２０２、光起電力素子２０３、基板２０４、冷却部材２０５を用意した。

【００６４】（封止材外層）封止材外層２０１として、白板ガラス（１ｍｍ厚）を用意した。

【００６５】（封止材内層の作成）封止材内層２０２として２液付加型液状シリコーン１００重量部と、フィラーとして酸化アルミニウム（平均粒径１μｍ）２４０重量部を用意した。以上を混合し脱気した。

【００６６】（光起電力素子）光起電力素子２０３として、単結晶シリコンの光起電力素子を用意した。

【００６７】（基板）基板２０４として、銅／窒化アルミニウム／銅の三層積層構造の基板を用意した。

【００６８】（冷却部材）冷却部材２０５として、ヒートシンクを用意した。

【００６９】以上の部材を以下の方法で組み立てた。

【００７０】基板２０４上の所定の位置に半田ペーストを印刷し、光起電力素子２０３を所定の位置に載置した。これをリフロー炉を用いて加熱、冷却し、基板２０４と光起電力素子２０３を一体化した。

【００７１】次に、冷却部材２０５に伝熱性の接着剤を塗布し、基板２０４と光起電力素子２０３を一体化したものと貼り合わせ、熱風乾燥炉で加熱硬化した。

【００７２】最後に、光起電力素子２０３上に封止材内層２０２を滴下し、その上に封止材外層２０１を載せ、真空チャンバーに入れて再度脱気を行った。その後、熱風乾燥炉で加熱硬化した。

【００７３】次に、シミュレーターを用いて、２５℃におけるレシーバーの電気的特性を測定した。

【００７４】また、得られたレシーバーを図３に示すフレネルレンズを用いた集光系にセットし、太陽電池モジュールを組み立てた。集光倍率は２５０倍とした。図３において、３０１はフレネルレンズ、３０２は筐体、３０３はレシーバーである。

【００７５】そして、得られた太陽電池モジュールを以下の手法で評価した。

【００７６】（屋外曝露試験）得られた太陽電池モジュールを図示しない太陽追尾装置に設置し、屋外暴露を行い、そこで光起電力素子の温度、太陽電池モジュールの変換効率を測定した。この変換効率の測定結果を、予めシミュレーターを用いて測定した値に対する相対値として表１に示す。

【００７７】（高温高湿試験）得られたレシーバーを８５℃、８５％、５０００時間の高温高湿試験を行った後、上記屋外曝露試験と同様に変換効率の測定を行った。更に外観を目視により評価した。以下の評価基準で評価を行い、その結果を表１に示す。

○：外観に変化を生じず、変換効率に３％以上の低下を生じないもの

△：外観に変化を生じず、変換効率に３％以上５％以下の低下を生じたもの

×：剥離等を生じたもの

【００７８】〔実施例２〕実施例１と同様にレシーバーを作成した。得られたレシーバーを図４に示す反射鏡を用いた太陽電池モジュールにセットした。集光倍率は２５０倍とした。図４において、４０１は反射鏡、４０２はレシーバーである。その評価結果を表１に示す。

【００７９】〔実施例３〕封止材外層を白板ガラスからポリクロロトリフルオロエチレンフィルム（厚み５０μｍ）に変更した以外は、実施例１と同様に行った。その評価結果を表１に示す。

【００８０】〔実施例４〕封止材外層を使用しない以外は、実施例１と同様に行った。その評価結果を表１に示す。

【００８１】〔比較例１〕封止材による封止を行わない以外は、実施例１と同様に行った。その評価結果を表１に示す。

【００８２】

【表１】

	屋外暴露		高温高湿試験
	温度(℃)	変換効率（相対値）	
実施例１	90	0.86	○
実施例２	90	0.86	○
実施例３	85	0.87	○
実施例４	80	0.88	△
比較例１	120	0.81	×

【００８３】表１から明らかなように、本発明の太陽電池モジュールは温度上昇が少なく、変換効率の低下を抑えることが可能である。また、光起電力素子を熱伝導性封止材で封止することにより、光起電力素子の信頼性を高めることが可能となった。

【００８４】

【発明の効果】以上説明したように、本発明の太陽電池モジュールによれば、集光型の太陽電池モジュールにおける光起電力素子を熱伝導性封止材で封止し、該封止材を介して光起電力素子の熱を他の部材もしくは大気に放出することにより、光起電力素子の温度上昇を防ぎ、変換効率の低下を防ぐことが可能となる。

【図面の簡単な説明】

【図１】本発明の太陽電池モジュールにおけるレシーバーの積層構成を示す概略図である。

【図２】実施例に係る太陽電池モジュールにおけるレシーバーの積層構成を示す概略図である。

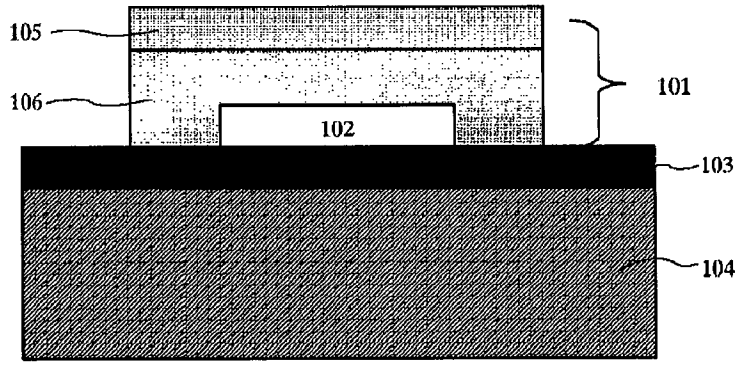
【図３】実施例及び比較例に係る太陽電池モジュールの構造を示す概略図である。

【図４】実施例２に係る太陽電池モジュールの構造を示す概略図である。

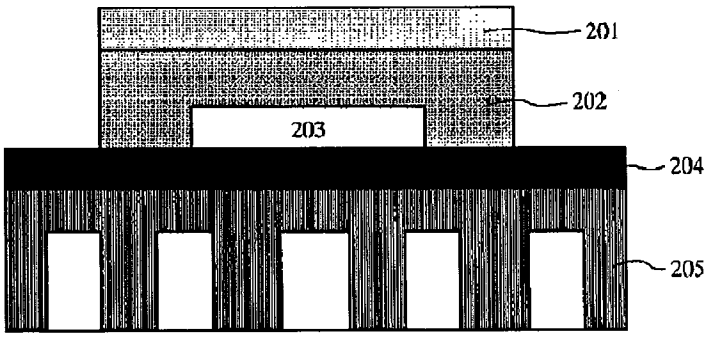
【符号の説明】

１０１　封止材
１０２　光起電力素子
１０３　基板
１０４　冷却部材
１０５　封止材外層
１０６　封止材内層
２０１　封止材外層
２０２　封止材内層
２０３　光起電力素子
２０４　基板
２０５　冷却部材
３０１　フレネルレンズ
３０２　筐体
３０３　レシーバー
４０１　反射鏡
４０２　レシーバー

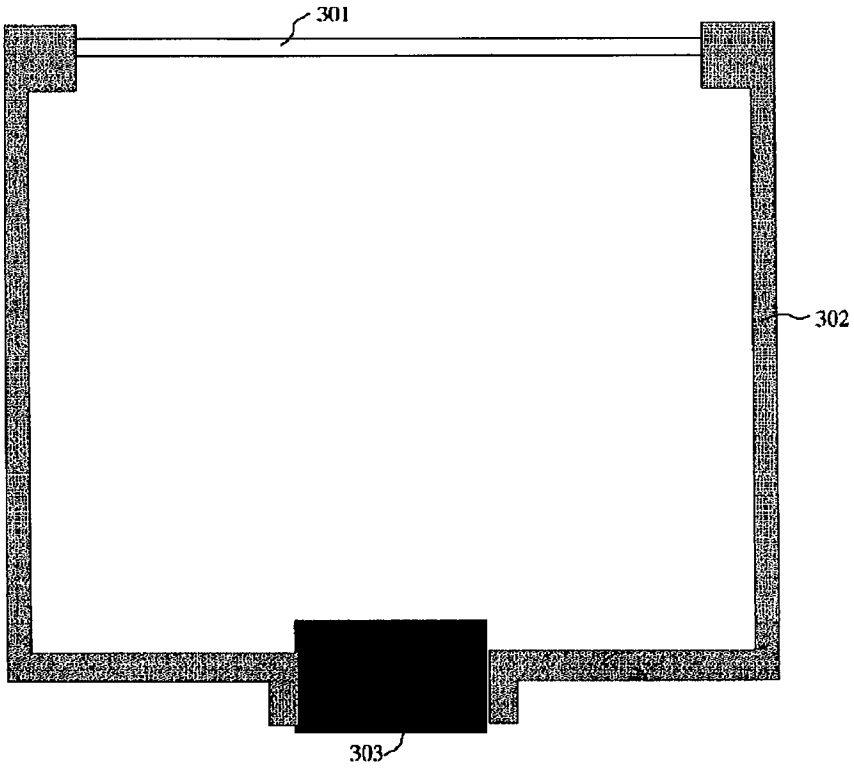
【図１】



【図２】



【図3】



【図4】